

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings of claims in the application:

Listing of Claims:

1. (previously presented) A storage device controlling apparatus including a plurality of first channel controllers, each of the first channel controllers being connected to a LAN and having a circuit board on which a file access processing section and an I/O processor are formed, the file access processing section receiving requests to input and output data in files as units sent from at least one information processing apparatus via a network, the I/O processor outputting I/O requests corresponding to said requests to input and output data to a storage device, said apparatus comprising:

a file lock table to be used by the file access processing section of the first channel controllers to perform exclusive control of a file, at a file level, on file accesses received by the file access processing section; and

a logical-volume lock table to be used by the I/O processor of the first channel controllers to perform exclusive control of a file, at a block level, on file accesses received by the file access processing section;

wherein if only one of the first channel controllers receives a plurality of requests to input/output data in a file of the first logical volume and the plurality of first channel controllers shares the first logical volume, a data area of the file is locked with the use of the file lock table to prohibit an I/O process for the others of the plurality of requests to input/output from being performed while the first channel controller performs an I/O process for one of the plurality of requests to input/output; and

wherein if more than one of the plurality of first channel controllers receive a plurality of requests to input/output data in a file of the first logical volume and the plurality of first channel controllers shares the first logical volume, the data area of the file is locked with the use of the logical volume lock table to prohibit an I/O process for the others of the plurality of

requests to input/output from being performed while an I/O process is performed for one of the plurality of requests to input/output.

2. (original) A storage device controlling apparatus according to claim 1, wherein said requests to input and output data are sent in accordance with at least two types of network file system protocols, and if, during said exclusive control which is performed upon accepting one of said requests to input and output data sent in accordance with one of network file system protocols, another said request to input/output data sent in accordance with another network file system protocol is accepted, an effect of said exclusive control is also reflected on the another request to input/output data.

3. (previously presented) A storage device controlling apparatus according to claim 1,

wherein a memory area of said storage device is managed in said first logical volume serving as a unit, the logical volume being logically set on the memory area, and said I/O processor performs exclusive control of said first logical volume in response to said exclusive control of the file.

4. (previously presented) A storage device controlling apparatus including a plurality of first channel controllers, each of the first channel controllers being connected to a LAN and having a circuit board on which a file access processing section and an I/O processor are formed, the file access processing section receiving requests to input and output data in files as units sent from an information processing apparatus via a network, the I/O processor outputting I/O requests corresponding to said requests to input and output data to a storage device, said apparatus comprising:

a section receiving from said information processing apparatus a request for information specifying a storage location of a file on a memory area of said storage device, and sending said information to said information processing apparatus;

a section receiving a request to read data in blocks as units from said information processing apparatus, in which the request is generated based on said information, and outputting an I/O request corresponding to the request to read data to said storage device;

a section sending data read from said storage device to said information processing apparatus;

a file lock table to be used by the file access processing section of the first channel controllers to perform exclusive control, at a file level, on file requests received by the file access processing section; and

a logical-volume lock table to be used by the I/O processor of the first channel controllers to perform exclusive control, at a block level, on file requests received by the file access processing section;

wherein if only one of the first channel controllers receives a plurality of requests to input/output data in a file of the first logical volume and the plurality of first channel controllers shares the first logical volume, a data area of the file is locked with the use of the file lock table to prohibit an I/O process for the others of the plurality of requests to input/output from being performed while the first channel controller performs an I/O process for one of the plurality of requests to input/output; and

wherein if more than one of the plurality of first channel controllers receive a plurality of requests to input/output data in a file of the first logical volume and the plurality of first channel controllers shares the first logical volume, the data area of the file is locked with the use of the logical volume lock table to prohibit an I/O process for the others of the plurality of requests to input/output from being performed while an I/O process is performed for one of the plurality of requests to input/output.

5. (previously presented) A storage device controlling apparatus according to claim 4, wherein the first channel controllers include at least one enabled to communicate with the information processing apparatus through a Fibre Channel.

6. (previously presented) A storage device controlling apparatus including a plurality of first channel controllers, each of the first channel controllers being connected to a

LAN and having a circuit board on which a file access processing section and an I/O processor are formed, the file access processing section receiving requests to input and output data in files as units sent from an information processing apparatus via a network, the I/O processor outputting I/O requests corresponding to said requests to input and output data to a storage device, said apparatus comprising:

- a section receiving from said information processing apparatus a request for information specifying a storage location of a file on a memory area of said storage device, and sending said information to said information processing apparatus;

- a section receiving a request to write data in blocks as units and data to be written from said information processing apparatus, in which the request is generated based on said information, and outputting to said storage device an I/O request corresponding to the request to write data and the data to be written;

- a file lock table to be used by the file access processing section of the first channel controllers to perform exclusive control, at a file level, on file requests received by the file access processing section; and

- a logical-volume lock table to be used by the I/O processor of the first channel controllers to perform exclusive control, at a block level, on file requests received by the file access processing section;

wherein if only one of the first channel controllers receives a plurality of requests to input/output data in a file of the first logical volume and the plurality of first channel controllers shares the first logical volume, a data area of the file is locked with the use of the file lock table to prohibit an I/O process for the others of the plurality of requests to input/output from being performed while the first channel controller performs an I/O process for one of the plurality of requests to input/output; and

wherein if more than one of the plurality of first channel controllers receive a plurality of requests to input/output data in a file of the first logical volume and the plurality of first channel controllers shares the first logical volume, the data area of the file is locked with the use of the logical volume lock table to prohibit an I/O process for the others of the plurality of

requests to input/output from being performed while an I/O process is performed for one of the plurality of requests to input/output.

7. (previously presented) A storage device controlling apparatus according to claim 6, wherein the first channel controllers include at least one enabled to communicate with the information processing apparatus through a Fibre Channel.

8. (previously presented) A storage device controlling apparatus including a plurality of first channel controllers, each of the first channel controllers being connected to a LAN and having a circuit board on which a file access processing section and an I/O processor are formed, the file access processing section receiving requests to input and output data in files as units sent from an information processing apparatus via a network, the I/O processor outputting I/O requests corresponding to said requests to input and output data to a storage device, said apparatus comprising:

a section setting at least one of logical volumes logically set on a memory area of said storage device as a shared first logical volume accessible from each of said first channel controllers;

a section performing fail-over based on take-over information of each of said first channel controllers, in which the take-over information is stored in said shared first logical volume and used when one of said first channel controllers takes over processing of another one of said first channel controllers;

a file lock table to be used by the file access processing section of the first channel controllers to perform exclusive control, at a file level, on file requests received by the file access processing section; and

a logical-volume lock table to be used by the I/O processor of the first channel controllers to perform exclusive control, at a block level, on file requests received by the file access processing section;

wherein if only one of the first channel controllers receives a plurality of requests to input/output data in a file of the first logical volume and the plurality of first channel controllers shares the first logical volume, a data area of the file is locked with the use of the file

lock table to prohibit an I/O process for the others of the plurality of requests to input/output from being performed while the first channel controller performs an I/O process for one of the plurality of requests to input/output; and

wherein if more than one of the plurality of first channel controllers receive a plurality of requests to input/output data in a file of the first logical volume and the plurality of first channel controllers shares the first logical volume, the data area of the file is locked with the use of the logical volume lock table to prohibit an I/O process for the others of the plurality of requests to input/output from being performed while an I/O process is performed for one of the plurality of requests to input/output.

9. (original) A storage device controlling apparatus according to claim 8, wherein said fail-over is performed in any one of cases where a request to perform said fail-over is received from said information processing apparatus and where a fault occurs in said another channel controller.

10. (previously presented) A storage device controlling apparatus including a plurality of first channel controllers, each of the first channel controllers being connected to a LAN and having a circuit board on which a file access processing section and an I/O processor are formed, the file access processing section receiving requests to input and output data in files as units sent from at least one information processing apparatus via a network, the I/O processor outputting I/O requests corresponding to said requests to input and output data to a storage device,

wherein said file access processing section stores identification information of accessible said information processing apparatus, and accepts said requests to input and output data only in a case where said requests to input and output data are sent from said information processing apparatus for which said identification information is stored;

wherein said apparatus further comprises:

a file lock table to be used by the file access processing section of the first channel controllers to perform exclusive control, at a file level, on file requests received by the file access processing section; and

a logical-volume lock table to be used by the I/O processor of the first channel controllers to perform exclusive control, at a block level, on file requests received by the file access processing section;

wherein if only one of the first channel controllers receives a plurality of requests to input/output data in a file of the first logical volume and the plurality of first channel controllers shares the first logical volume, a data area of the file is locked with the use of the file lock table to prohibit an I/O process for the others of the plurality of requests to input/output from being performed while the first channel controller performs an I/O process for one of the plurality of requests to input/output; and

wherein if more than one of the plurality of first channel controllers receive a plurality of requests to input/output data in a file of the first logical volume and the plurality of first channel controllers shares the first logical volume, the data area of the file is locked with the use of the logical volume lock table to prohibit an I/O process for the others of the plurality of requests to input/output from being performed while an I/O process is performed for one of the plurality of requests to input/output.

11. (previously presented) A method of controlling a storage device controlling apparatus including a plurality of first channel controllers, each of the first channel controllers being connected to a LAN and having a circuit board on which a file access processing section and an I/O processor are formed, the file access processing section receiving requests to input and output data in files as units sent from at least one information processing apparatus via a network, the I/O processor outputting I/O requests corresponding to said requests to input and output data to a storage device, said method comprising:

receiving said requests to input and output data of a file from said information processing apparatus by said first channel controller; [[and]]

performing exclusive control of said file, which includes performing exclusive control by the access processing section of the first channel controllers, at a file level, on file requests received by the file access processing section using a file lock table, and performing

exclusive control by the I/O processor of the first channel controllers, at a block level, on file requests received by the file access processing section using a logical-volume lock table; and

wherein if only one of the first channel controllers receives a plurality of requests to input/output data in a file of the first logical volume and the plurality of first channel controllers shares the first logical volume, a data area of the file is locked with the use of the file lock table to prohibit an I/O process for the others of the plurality of requests to input/output from being performed while the first channel controller performs an I/O process for one of the plurality of requests to input/output; and

wherein if more than one of the plurality of first channel controllers receive a plurality of requests to input/output data in a file of the first logical volume and the plurality of first channel controllers shares the first logical volume, the data area of the file is locked with the use of the logical volume lock table to prohibit an I/O process for the others of the plurality of requests to input/output from being performed while an I/O process is performed for one of the plurality of requests to input/output.

12. (original) A method of controlling the storage device controlling apparatus according to claim 11, wherein said requests to input and output data are sent in accordance with at least two types of network file system protocols, and if, during said exclusive control which is performed upon accepting one of said requests to input and output data sent in accordance with one of the network file system protocols, another said request to input/output data sent in accordance with another network file system protocol is accepted, an effect of said exclusive control is also reflected on the another request to input/output data.

13. (previously presented) A method of controlling the storage device controlling apparatus according to claim 11,

wherein a memory area of said storage device is managed in said first logical volume serving as a unit, the logical volume logically being set on the memory area, and

said I/O processor performs exclusive control of said first logical volume in response to said exclusive control of the file.

14. (previously presented) A method of controlling a storage device controlling apparatus including:

a plurality of first channel controllers, each of the first channel controllers being connected to a LAN and having a circuit board on which a file access processing section and an I/O processor are formed, the file access processing section receiving requests to input and output data in files as units sent from an information processing apparatus via a network, the I/O processor outputting I/O requests corresponding to said requests to input and output data to a storage device; and

a section receiving a request to read data in blocks as units sent from said information processing apparatus, and outputting an I/O request corresponding to the request to read data to said storage device, said method comprising:

receiving a request for information specifying a storage location of a file on a memory area of said storage device from said information processing apparatus, and sending said information to said information processing apparatus;

receiving said request to read data in blocks as units from said information processing apparatus, in which the request is generated based on said information;

performing exclusive control by the access processing section of the first channel controllers, at a file level, on file requests received by the file access processing section using a file lock table, and performing exclusive control by the I/O processor of the first channel controllers, at a block level, on file requests received by the file access processing section using a logical-volume lock table;

outputting said I/O request corresponding to said request to read data to said storage device; and

sending data read from said storage device to said information processing apparatus;

wherein if only one of the first channel controllers receives a plurality of requests to input/output data in a file of the first logical volume and the plurality of first channel controllers shares the first logical volume, a data area of the file is locked with the use of the file lock table to prohibit an I/O process for the others of the plurality of requests to input/output

from being performed while the first channel controller performs an I/O process for one of the plurality of requests to input/output; and

wherein if more than one of the plurality of first channel controllers receive a plurality of requests to input/output data in a file of the first logical volume and the plurality of first channel controllers shares the first logical volume, the data area of the file is locked with the use of the logical volume lock table to prohibit an I/O process for the others of the plurality of requests to input/output from being performed while an I/O process is performed for one of the plurality of requests to input/output.

15. (previously presented) A storage device controlling apparatus according to claim 14, wherein the first channel controllers include at least one enabled to communicate with the information processing apparatus through a Fibre Channel.

16. (previously presented) A method of controlling a storage device controlling apparatus including:

a plurality of first channel controllers, each of the first channel controllers being connected to a LAN and having a circuit board on which a file access processing section and an I/O processor are formed, the file access processing section receiving requests to input and output data sent in files as units from an information processing apparatus via a network, the I/O processor outputting I/O requests corresponding to said requests to input and output data to a storage device; and

a section receiving a request to write data in blocks as units sent from said information processing apparatus, and outputting an I/O request corresponding to the request to write data to said storage device, said method comprising:

receiving a request for information specifying a storage location of a file on a memory area of said storage device from said information processing apparatus, and sending said information to said information processing apparatus;

receiving said request to write data in blocks as units and data to be written from said information processing apparatus, in which the request is generated based on said information;

performing exclusive control by the access processing section of the first channel controllers, at a file level, on file requests received by the file access processing section using a file lock table, and performing exclusive control by the I/O processor of the first channel controllers, at a block level, on file requests received by the file access processing section using a logical-volume lock table; and

outputting said I/O request corresponding to said request to write data and said data to be written to said storage device;

wherein if only one of the first channel controllers receives a plurality of requests to input/output data in a file of the first logical volume and the plurality of first channel controllers shares the first logical volume, a data area of the file is locked with the use of the file lock table to prohibit an I/O process for the others of the plurality of requests to input/output from being performed while the first channel controller performs an I/O process for one of the plurality of requests to input/output; and

wherein if more than one of the plurality of first channel controllers receive a plurality of requests to input/output data in a file of the first logical volume and the plurality of first channel controllers shares the first logical volume, the data area of the file is locked with the use of the logical volume lock table to prohibit an I/O process for the others of the plurality of requests to input/output from being performed while an I/O process is performed for one of the plurality of requests to input/output.

17. (previously presented) A storage device controlling apparatus according to claim 16, wherein the first channel controllers include at least one enabled to communicate with the information processing apparatus through a Fibre Channel.

18. (previously presented) A method of controlling a storage device controlling apparatus including a plurality of first channel controllers, each of the first channel controllers being connected to a LAN and having a circuit board on which a file access processing section and an I/O processor are formed, the file access processing section receiving requests to input and output data in files as units sent from an information processing apparatus

via a network, the I/O processor outputting I/O requests corresponding to said data to input and output data to a storage device, said method comprising:

performing exclusive control by the access processing section of the first channel controllers, at a file level, on file requests received by the file access processing section using a file lock table, and performing exclusive control by the I/O processor of the first channel controllers, at a block level, on file requests received by the file access processing section using a logical-volume lock table;

setting at least one of logical volumes logically set on a memory area of said storage device as a shared first logical volume accessible from each of said first channel controllers; and

performing fail-over based on take-over information of each of said first channel controllers, in which the take-over information is stored in said shared first logical volume and used when one of said first channel controllers takes over processing of another one of said first channel controllers;

wherein if only one of the first channel controllers receives a plurality of requests to input/output data in a file of the first logical volume and the plurality of first channel controllers shares the first logical volume, a data area of the file is locked with the use of the file lock table to prohibit an I/O process for the others of the plurality of requests to input/output from being performed while the first channel controller performs an I/O process for one of the plurality of requests to input/output; and

wherein if more than one of the plurality of first channel controllers receive a plurality of requests to input/output data in a file of the first logical volume and the plurality of first channel controllers shares the first logical volume, the data area of the file is locked with the use of the logical volume lock table to prohibit an I/O process for the others of the plurality of requests to input/output from being performed while an I/O process is performed for one of the plurality of requests to input/output.

19. (original) A method of controlling the storage device controlling apparatus according to claim 18, wherein said fail-over is performed in any one of cases where a

request to perform said fail-over is received from said information processing apparatus and where a fault occurs in said another channel controller.

20. (previously presented) A method of controlling a storage device controlling apparatus including a plurality of first channel controllers, each of the first channel controllers being connected to a LAN and having a circuit board on which a file access processing section and an I/O processor are formed, the file access processing section receiving requests to input and output data in files as units sent from at least one information processing apparatus via a network, the I/O processor outputting I/O requests corresponding to said requests to input and output data to a storage device, said method comprising:

performing exclusive control by the access processing section of the first channel controllers, at a file level, on file requests received by the file access processing section using a file lock table, and performing exclusive control by the I/O processor of the first channel controllers, at a block level, on file requests received by the file access processing section using a logical-volume lock table;

storing identification information of accessible said information processing apparatus by said file access processing section; and

accepting said requests to input and output data only in a case where said requests to input and output data are sent from said information processing apparatus for which said identification information is stored;

wherein if only one of the first channel controllers receives a plurality of requests to input/output data in a file of the first logical volume and the plurality of first channel controllers shares the first logical volume, a data area of the file is locked with the use of the file lock table to prohibit an I/O process for the others of the plurality of requests to input/output from being performed while the first channel controller performs an I/O process for one of the plurality of requests to input/output; and

wherein if more than one of the plurality of first channel controllers receive a plurality of requests to input/output data in a file of the first logical volume and the plurality of first channel controllers shares the first logical volume, the data area of the file is locked with the

use of the logical volume lock table to prohibit an I/O process for the others of the plurality of requests to input/output from being performed while an I/O process is performed for one of the plurality of requests to input/output.

21. (previously presented) The storage device controlling apparatus of claim 1 further comprising a second channel controller connected to a SAN and having an I/O processor which processes requests to input/output that have been received via the SAN;

wherein when one of the plurality of first channel controllers and the second channel controller share a second logical volume, if the one of the plurality of first channel controllers and the second channel controller receive a plurality of requests to input/output data in the second logical volume, control is performed wherein an I/O process is performed for one of the plurality of requests to input/output, during which the data area of the file is locked with use of the logical volume lock table, thereby prohibiting an I/O process for the others of the plurality of requests to input/output from being performed.

22. (previously presented) The storage device controlling apparatus of claim 4 further comprising a second channel controller connected to a SAN and having an I/O processor which processes requests to input/output that have been received via the SAN;

wherein when one of the plurality of first channel controllers and the second channel controller share a second logical volume, if the one of the plurality of first channel controllers and the second channel controller receive a plurality of requests to input/output data in the second logical volume, control is performed wherein an I/O process is performed for one of the plurality of requests to input/output, during which the data area of the file is locked with use of the logical volume lock table, thereby prohibiting an I/O process for the others of the plurality of requests to input/output from being performed.

23. (previously presented) The storage device controlling apparatus of claim 6 further comprising a second channel controller connected to a SAN and having an I/O processor which processes requests to input/output that have been received via the SAN;

wherein when one of the plurality of first channel controllers and the second channel controller share a second logical volume, if the one of the plurality of first channel controllers and the second channel controller receive a plurality of requests to input/output data in the second logical volume, control is performed wherein an I/O process is performed for one of the plurality of requests to input/output, during which the data area of the file is locked with use of the logical volume lock table, thereby prohibiting an I/O process for the others of the plurality of requests to input/output from being performed.

24. (previously presented) The storage device controlling apparatus of claim 8 further comprising a second channel controller connected to a SAN and having an I/O processor which processes requests to input/output that have been received via the SAN;

wherein when one of the plurality of first channel controllers and the second channel controller share a second logical volume, if the one of the plurality of first channel controllers and the second channel controller receive a plurality of requests to input/output data in the second logical volume, control is performed wherein an I/O process is performed for one of the plurality of requests to input/output, during which the data area of the file is locked with use of the logical volume lock table, thereby prohibiting an I/O process for the others of the plurality of requests to input/output from being performed.

25. (previously presented) The storage device controlling apparatus of claim 10 further comprising a second channel controller connected to a SAN and having an I/O processor which processes requests to input/output that have been received via the SAN;

wherein when one of the plurality of first channel controllers and the second channel controller share a second logical volume, if the one of the plurality of first channel controllers and the second channel controller receive a plurality of requests to input/output data in the second logical volume, control is performed wherein an I/O process is performed for one of the plurality of requests to input/output, during which the data area of the file is locked with use of the logical volume lock table, thereby prohibiting an I/O process for the others of the plurality of requests to input/output from being performed.

26. (previously presented) The method of claim 11 wherein the storage device controlling apparatus further includes a second channel controller connected to a SAN and having an I/O processor which processes requests to input/output that have been received via the SAN;

wherein when one of the plurality of first channel controllers and the second channel controller share a second logical volume, if the one of the plurality of first channel controllers and the second channel controller receive a plurality of requests to input/output data in the second logical volume, control is performed wherein an I/O process is performed for one of the plurality of requests to input/output, during which the data area of the file is locked with use of the logical volume lock table, thereby prohibiting an I/O process for the others of the plurality of requests to input/output from being performed.

27. (previously presented) The method of claim 14 wherein the storage device controlling apparatus further includes a second channel controller connected to a SAN and having an I/O processor which processes requests to input/output that have been received via the SAN;

wherein when one of the plurality of first channel controllers and the second channel controller share a second logical volume, if the one of the plurality of first channel controllers and the second channel controller receive a plurality of requests to input/output data in the second logical volume, control is performed wherein an I/O process is performed for one of the plurality of requests to input/output, during which the data area of the file is locked with use of the logical volume lock table, thereby prohibiting an I/O process for the others of the plurality of requests to input/output from being performed.

28. (previously presented) The method of claim 16 wherein the storage device controlling apparatus further includes a second channel controller connected to a SAN and having an I/O processor which processes requests to input/output that have been received via the SAN;

wherein when one of the plurality of first channel controllers and the second channel controller share a second logical volume, if the one of the plurality of first channel

controllers and the second channel controller receive a plurality of requests to input/output data in the second logical volume, control is performed wherein an I/O process is performed for one of the plurality of requests to input/output, during which the data area of the file is locked with use of the logical volume lock table, thereby prohibiting an I/O process for the others of the plurality of requests to input/output from being performed.

29. (previously presented) The method of claim 18 wherein the storage device controlling apparatus further includes a second channel controller connected to a SAN and having an I/O processor which processes requests to input/output that have been received via the SAN;

wherein when one of the plurality of first channel controllers and the second channel controller share a second logical volume, if the one of the plurality of first channel controllers and the second channel controller receive a plurality of requests to input/output data in the second logical volume, control is performed wherein an I/O process is performed for one of the plurality of requests to input/output, during which the data area of the file is locked with use of the logical volume lock table, thereby prohibiting an I/O process for the others of the plurality of requests to input/output from being performed.

30. (previously presented) The method of claim 20 wherein the storage device controlling apparatus further includes a second channel controller connected to a SAN and having an I/O processor which processes requests to input/output that have been received via the SAN;

wherein when one of the plurality of first channel controllers and the second channel controller share a second logical volume, if the one of the plurality of first channel controllers and the second channel controller receive a plurality of requests to input/output data in the second logical volume, control is performed wherein an I/O process is performed for one of the plurality of requests to input/output, during which the data area of the file is locked with use of the logical volume lock table, thereby prohibiting an I/O process for the others of the plurality of requests to input/output from being performed.